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Tsai et al.

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(54) **ELECTRICAL CONNECTOR**

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Jan. 28, 2011 (CN) ..... 2011 2 0031855 U

(51) **Int. Cl.**
H01R 12/00 (2006.01)

(52) **U.S. Cl.** **439/83**; 439/66

(58) **Field of Classification Search** 439/83, 439/66, 343, 342, 876, 76, 78, 346, 855, 439/858

See application file for complete search history.

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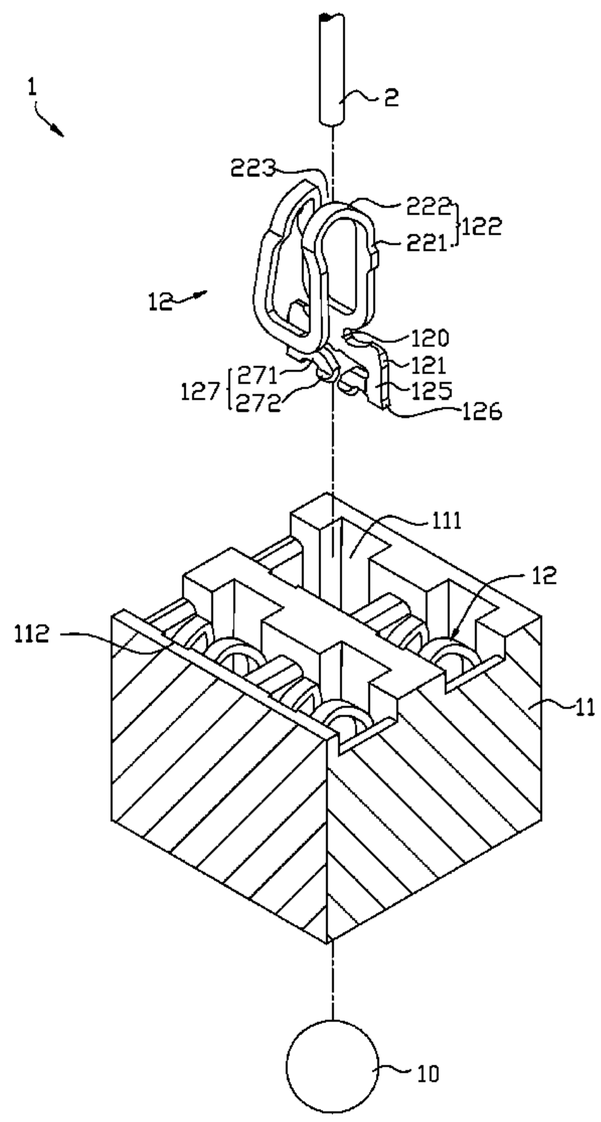
(57) **ABSTRACT**

An electrical connector with a plurality of solder balls arranged therein. In one embodiment, the electrical connector includes: an insulating body, wherein a plurality of receiving slots are formed through the insulating body, and at least one side surface of each receiving slot forms a stop wall; and a plurality of conductive terminals, received in the receiving slots. Each conductive terminal has a base, at least one fixing portion extends downwards from the base, and a soldering portion is bent laterally and extends from the fixing portion. The soldering portion includes a soldering arm and a hook portion bent and extending from a lower end of the soldering arm towards the stop wall. The solder ball is clamped between the soldering portion and the stop wall. The hook portion has at least one retaining point urging against a lower hemispherical surface of the solder ball.

11 Claims, 9 Drawing Sheets



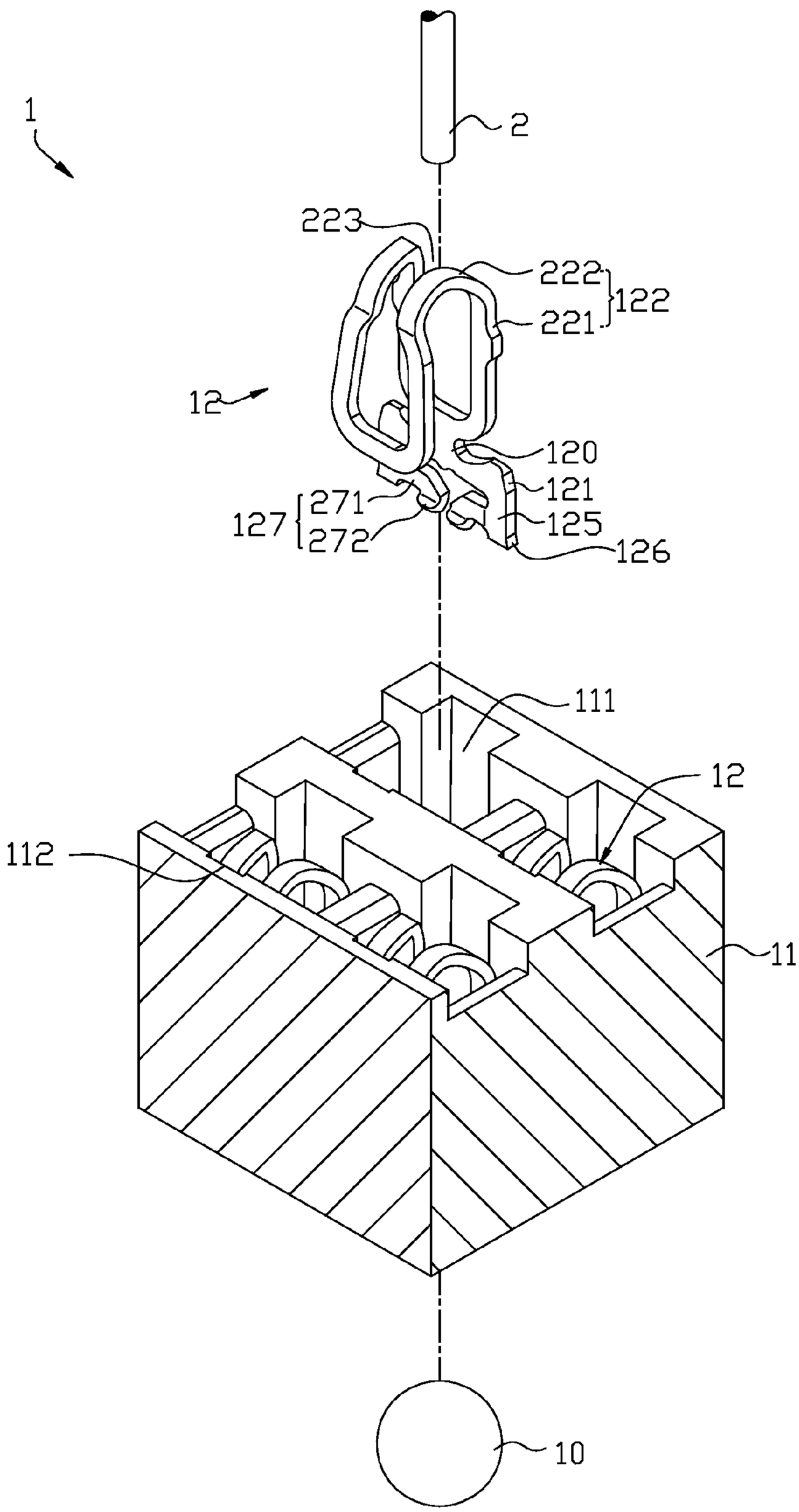


FIG. 1

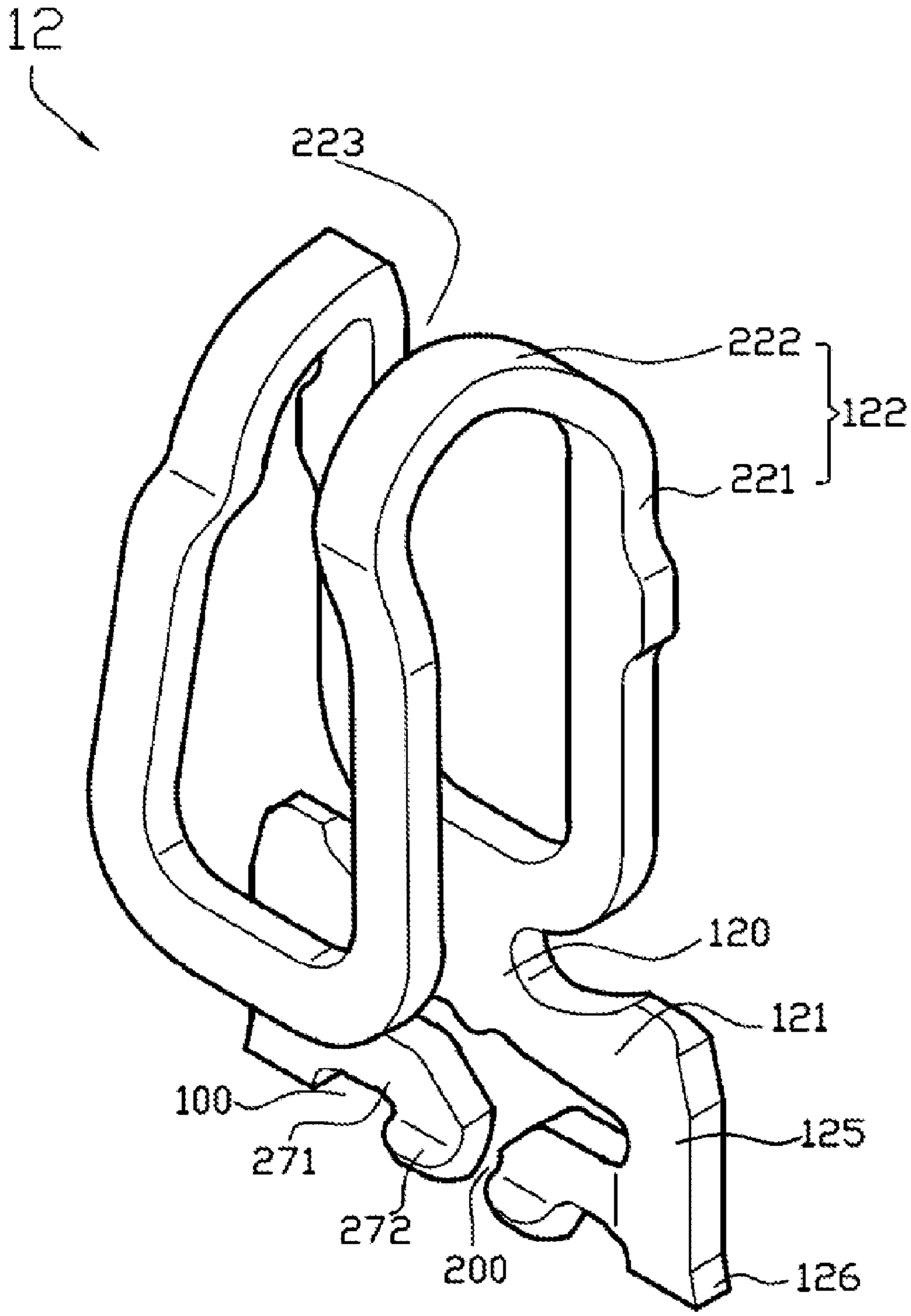


FIG. 2

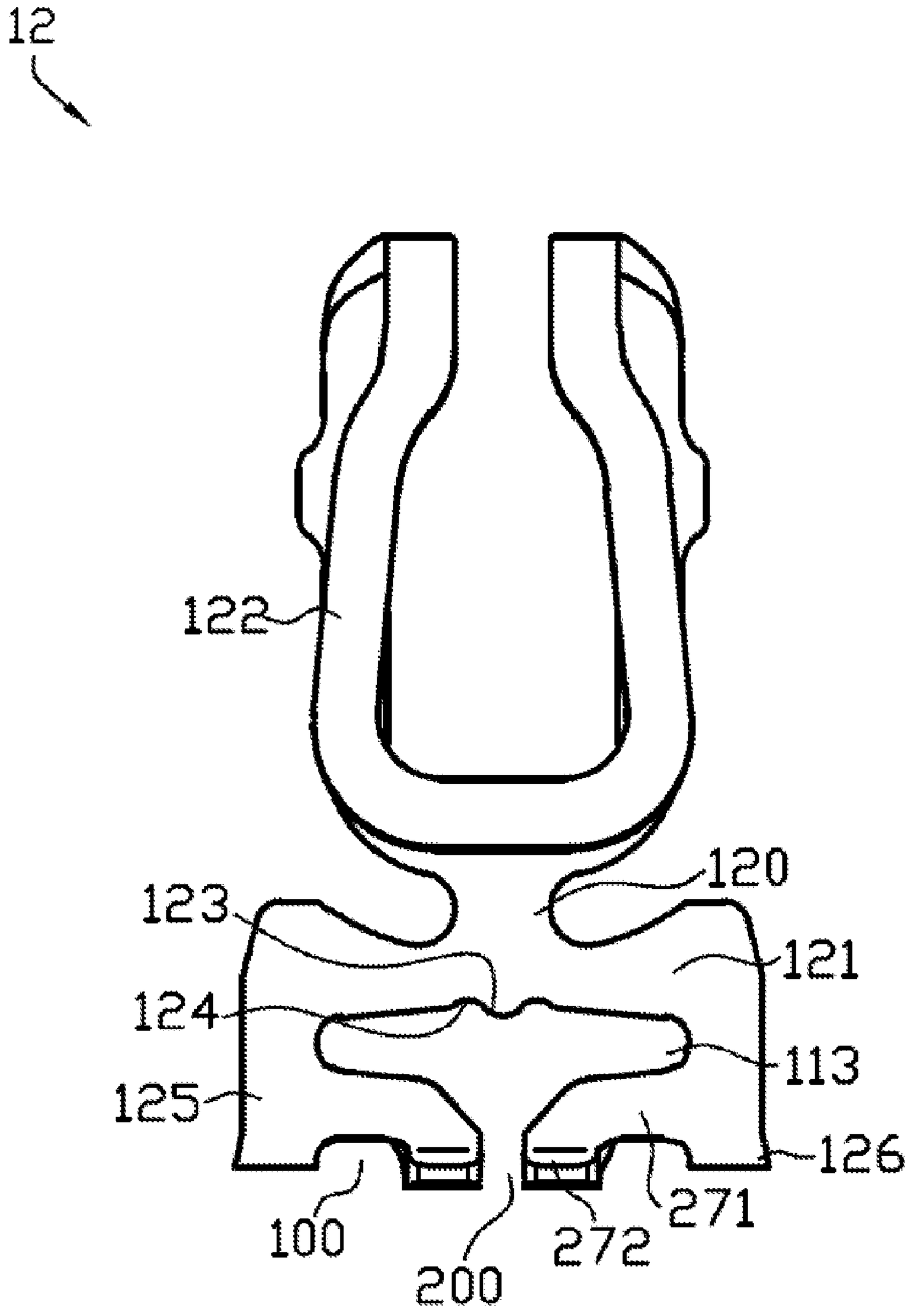


FIG. 3

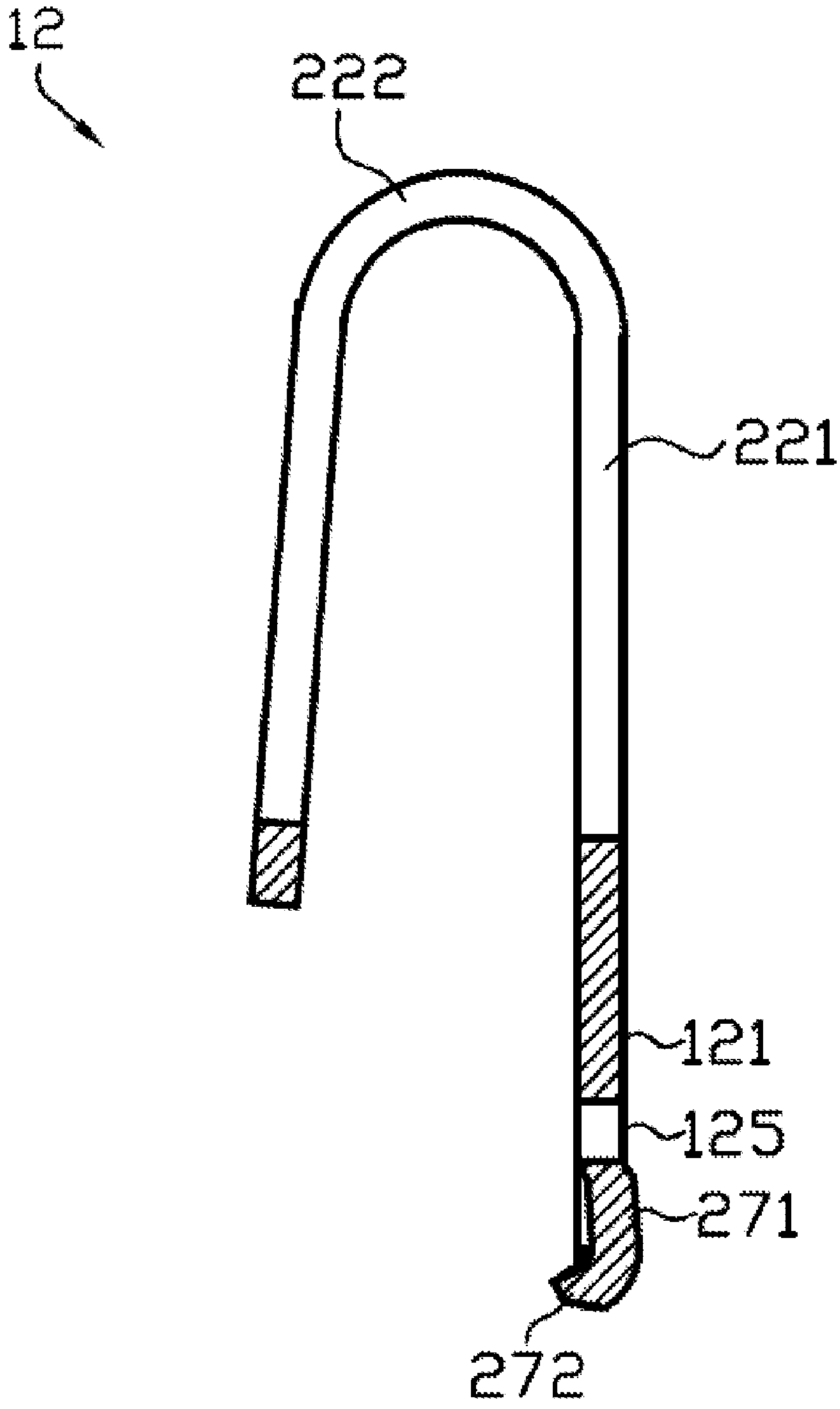


FIG. 4

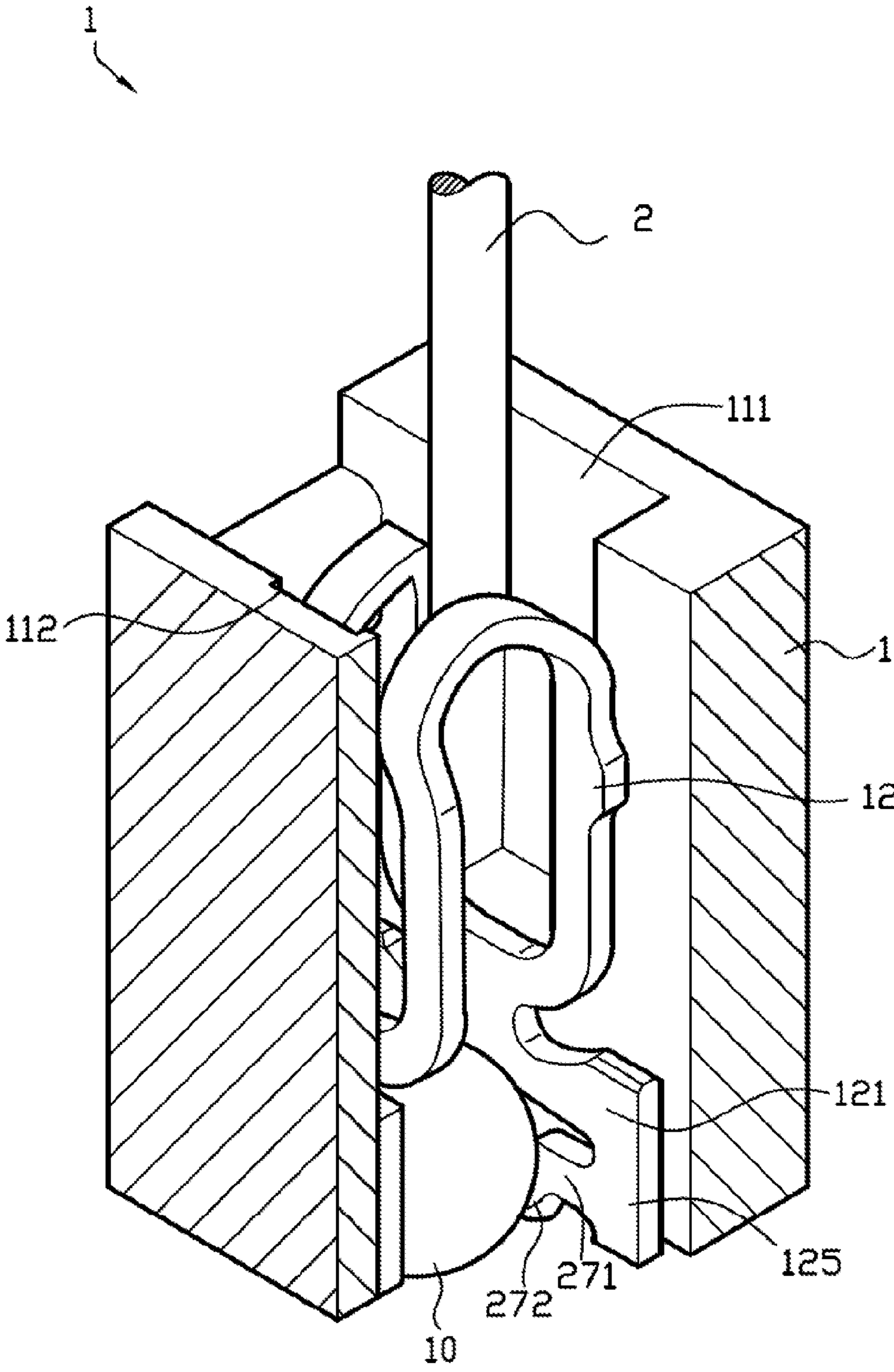


FIG. 5

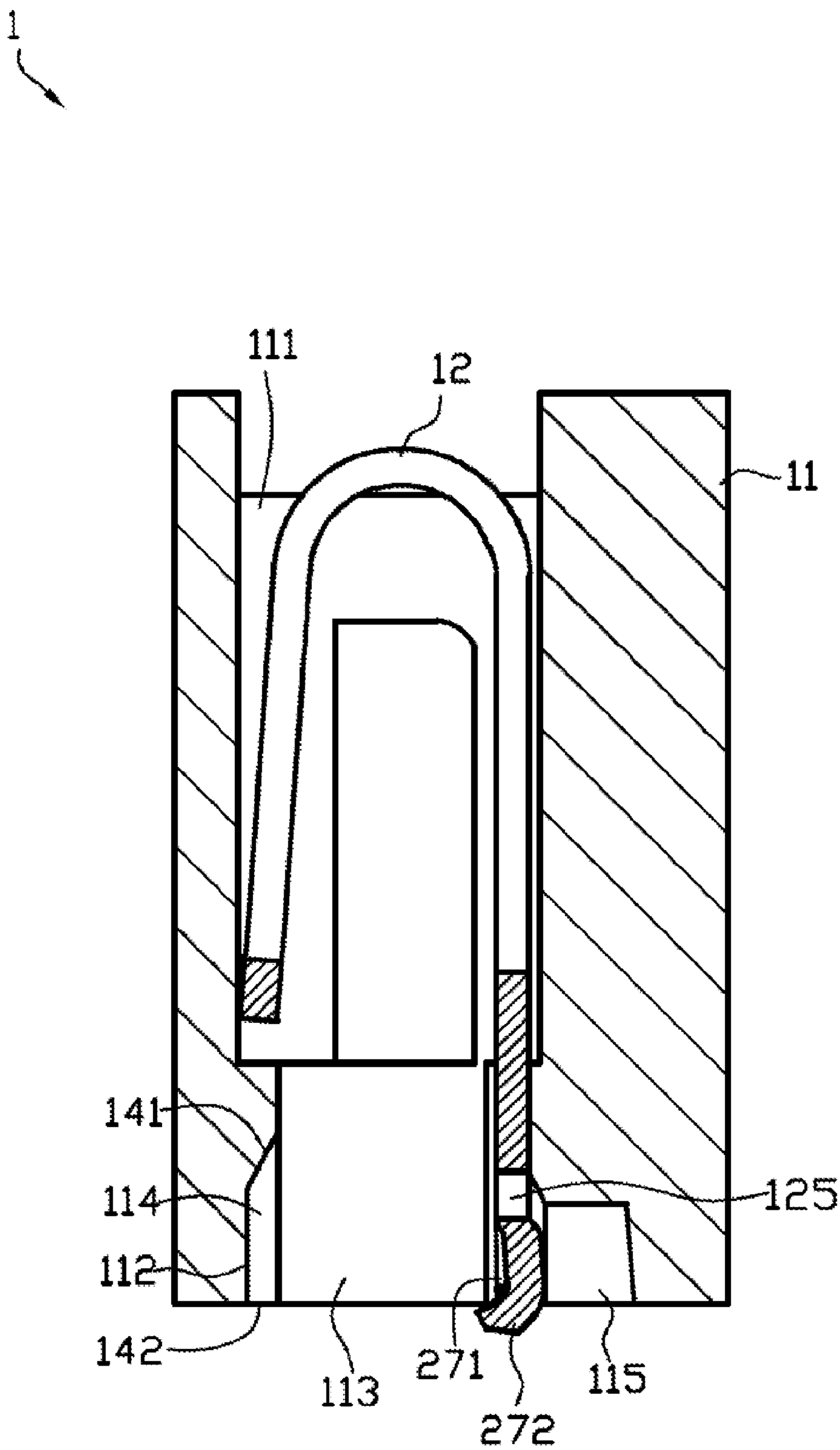


FIG. 6

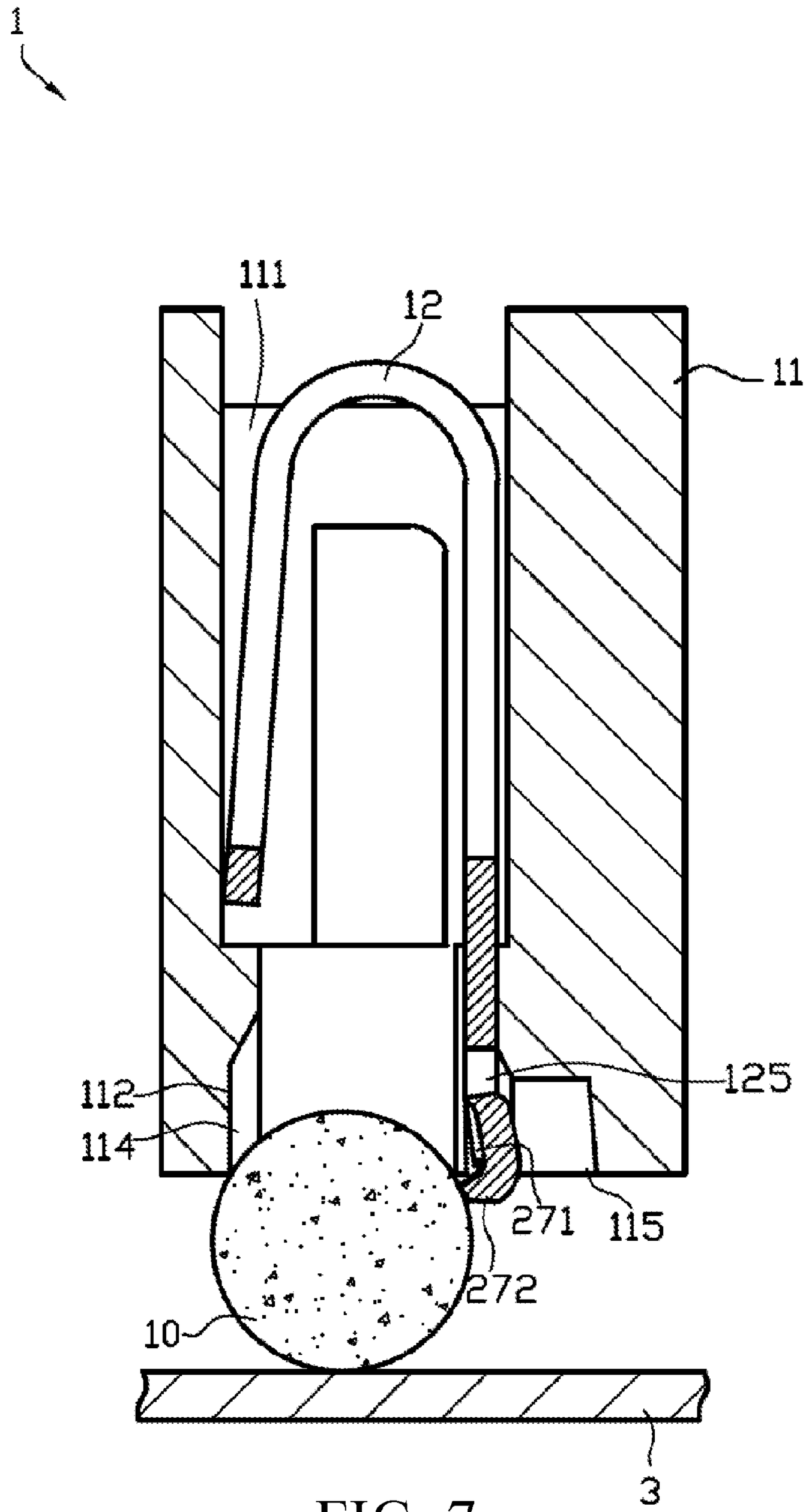


FIG. 7

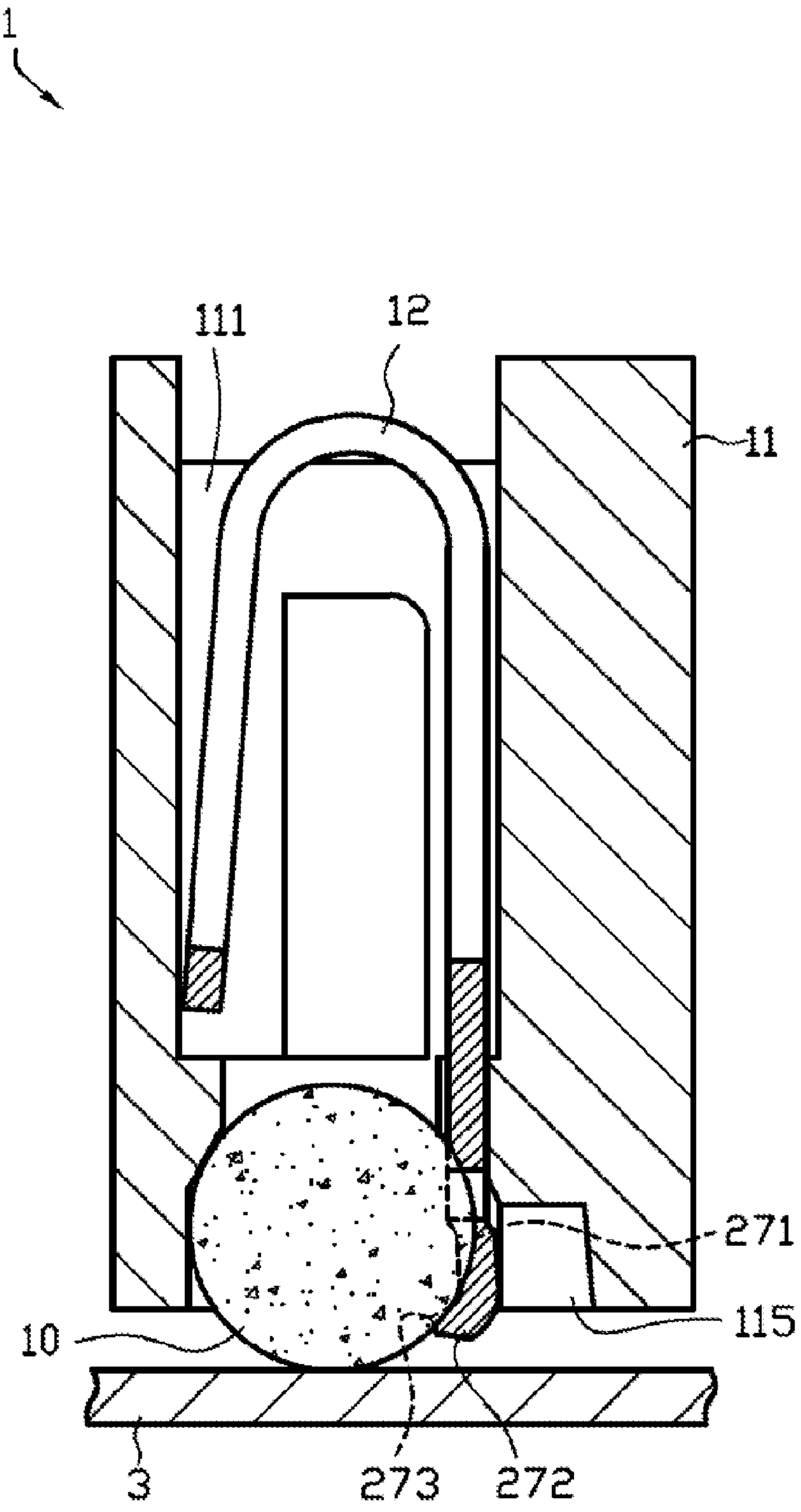


FIG. 8

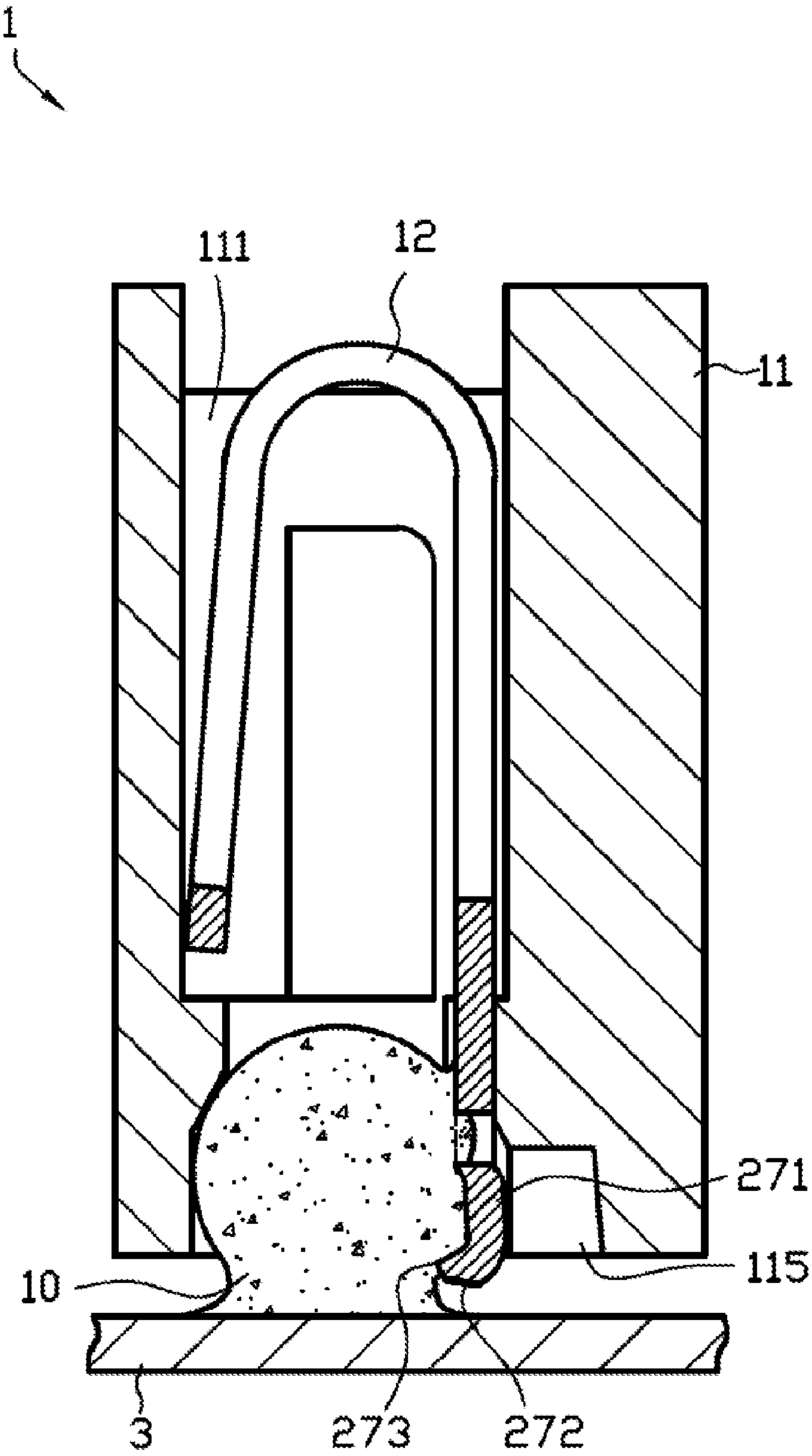


FIG. 9

ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims priority under 35 U.S.C. §119(a) on Patent Application No. 201120031855.2 filed in China on Jan. 28, 2011, the entire contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to an electrical connector, and more particularly to an electrical connector for connecting a chip module.

BACKGROUND OF THE INVENTION

An electrical connector commonly seen in the industry has a plurality of solder balls arranged therein, and includes: an insulating body, wherein a plurality of receiving slots are formed through the insulating body, and at least one side of each receiving slot forms a stop wall; and a plurality of conductive terminals, wherein each conductive terminal is correspondingly received in one of the receiving slots, each conductive terminal has a base, two soldering portions extend vertically downwards from the base, the solder ball is movably received between the stop wall and the two soldering portions, and the two soldering portions are both in contact with the most protruding portions of the solder ball.

In the prior art, the electrical connector has the following defects.

1. Since the soldering portions extend vertically downwards from the base, the two soldering portions must cooperate with the stop wall so as to retain the solder ball. Since the soldering portions are both in contact with the most protruding portions of the solder ball, the solder ball may be displaced relative to the prearranged position during transportation or other unexpected operations. Since the soldering portions are only in contact with the most protruding portions of the solder ball, the solder ball may move upwards and downwards relative to the receiving slot once departing from the prearranged position, resulting in poor soldering.

2. In a soldering environment without inert gases, when a solder paste is provided to solder the conductive terminal onto a circuit board located below the insulating body through the solder ball, since the two soldering portions are both in contact with the most protruding portions of the solder ball, a height difference exists between the solder paste and the two soldering portions, so that the solder paste and the soldering portions cannot contact each other over a large area, and the solder flux in the solder paste is not sufficient to remove the oxide layer on the surface of the soldering portion. As such, the soldering portions cannot fully electrically contact the solder ball, resulting in poor soldering.

3. The most important is that, when the solder ball is inserted and presses against the soldering portions, the soldering portions elastically move away from the stop wall, and when the solder ball reaches the prearranged position, an elastic restoring force exerted on the solder ball by the soldering portions is limited as the soldering portions extend vertically downwards from the base, which leads to a small elastic restoring force and slow elastic restoration, so that the soldering portions cannot be in close interference with the solder ball.

Therefore, a heretofore unaddressed need exists in the art to address the aforementioned deficiencies and inadequacies.

SUMMARY OF THE INVENTION

In one aspect, the present invention is directed to an electrical connector capable of securely retaining a solder ball.

In one embodiment, the present invention provides an electrical connector with a plurality of solder balls arranged therein. The electrical connector includes an insulating body, wherein a plurality of receiving slots are formed through the insulating body, and at least one side surface of each receiving slot forms a stop wall; and a plurality of conductive terminals, received in the receiving slots, wherein each conductive terminal has a base, at least one fixing portion extends downwards from the base, a soldering portion is bent laterally and extends from the fixing portion, the soldering portion includes a soldering arm and a hook portion bent and extending from a lower end of the soldering arm towards the stop wall, the solder ball is clamped between the soldering portion and the stop wall, and the hook portion has at least one retaining point urging against a lower hemispherical surface of the solder ball.

Compared with the prior art, among other things, the electrical connector of the present invention has the following advantages.

1. The hook portion is bent and extends from the lower end of the soldering arm towards the stop wall, the solder ball is clamped between the soldering portion and the stop wall, and the hook portion has at least one retaining point urging against the lower hemispherical surface of the solder ball, so that during transportation or other unexpected operations, the retaining point can prevent the solder ball from moving upwards and downwards relative to the receiving slot, thereby ensuring good soldering.

2. In a soldering environment without inert gases, when a solder paste is provided to solder the conductive terminal onto a circuit board located below the insulating body through the solder ball, since the hook portion has at least one retaining point urging against the lower hemispherical surface of the solder ball, that is, the height difference between the solder paste and the hook portion is small, the solder paste contacts the hook portion over a large area, and the solder flux in the solder paste is sufficient to remove the oxide layer on the surface of the hook portion. As such, the hook portion fully electrically contacts the solder ball, thereby ensuring good soldering.

These and other aspects of the present invention will become apparent from the following description of the preferred embodiment taken in conjunction with the following drawings, although variations and modifications therein may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate one or more embodiments of the invention and together with the written description, serve to explain the principles of the invention. Wherever possible, the same reference numbers are used throughout the drawings to refer to the same or like elements of an embodiment, and wherein:

FIG. **1** is a three-dimensional exploded view of an electrical connector in one embodiment of the present invention;

FIG. **2** is a schematic view of a conductive terminal of the electrical connector in one embodiment of the present invention;

FIG. **3** is a front view of the conductive terminal of the electrical connector in one embodiment of the present invention;

FIG. **4** is a sectional view of the conductive terminal of the electrical connector in one embodiment of the present invention;

FIG. **5** is a schematic assembled view of the electrical connector in one embodiment of the present invention;

FIG. **6** is a sectional view of the electrical connector in one embodiment of the present invention with no solder ball inserted therein;

FIG. **7** is a sectional view of the electrical connector in one embodiment of the present invention when the solder ball partially enters a retaining space;

FIG. **8** is a sectional view of the electrical connector in one embodiment of the present invention when the solder ball substantially enters a retaining space; and

FIG. **9** is a sectional view of the electrical connector in one embodiment of the present invention when the solder ball is in a molten state.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is more particularly described in the following examples that are intended as illustrative only since numerous modifications and variations therein will be apparent to those skilled in the art. Various embodiments of the invention are now described in detail. Referring to the drawings, like numbers indicate like components throughout the views. As used in the description herein and throughout the claims that follow, the meaning of "a", "an", and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein and throughout the claims that follow, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

Referring to FIG. **1** and FIG. **7**, the electrical connector **1** in one embodiment of the present invention is used for electrically connecting an electronic component **2** to a circuit board **3**.

Referring to FIG. **1** and FIG. **2**, the electrical connector **1** has a plurality of solder balls **10** arranged therein, and includes an insulating body **11** and a plurality of conductive terminals **12** received in the insulating body **11**.

Referring to FIG. **1** and FIG. **6**, the insulating body **11** is formed by injection molding. A plurality of receiving slots **111** are formed through the insulating body **11**. A side surface of each receiving slot **111** forms a stop wall **112**. A retaining space **113** for receiving one of the solder balls **10** is formed at an end of the receiving slot **111** adjacent to the circuit board **3**. The retaining space **113** is recessed with a limiting groove **114**. The limiting groove **114** has a first stop surface **141** and a second stop surface **142**. The first stop surface **141** and the second stop surface **142** are disposed opposite to each other to stop upward and downward displacements of the solder ball **10**. The stop wall **112** and the conductive terminal **12** are disposed opposite to each other to stop leftward and rightward displacements of the solder ball **10**. The first stop surface **141**, the second stop surface **142** and the stop wall **112** jointly surround the solder ball **10** to stop a spatial displacement of the solder ball **10**.

Referring to FIG. **1**, FIG. **6** and FIG. **7**, the retaining space **113** extends away from the stop wall **112** to form a reserved space **115** allowing the conductive terminal **12** to move towards a side surface opposite to the stop wall **112** when the solder ball **10** is forced to enter the retaining space **113**. The reserved space **115** is connected with the retaining space **113**.

When the solder ball **10** does not enter the retaining space **113**, the conductive terminal **12** is located in the retaining space **113**. When the solder ball **10** is forced to enter the retaining space **113**, the conductive terminal **12** elastically moves towards the reserved space **115** and partially enters the reserved space **115**.

Referring to FIGS. **2-4**, the conductive terminal **12** is formed by stamping a metal plate, and is substantially in the shape of an inverted U. Each conductive terminal **12** has a base **121** received in the receiving slot **111**, and the base **121** is substantially in a flat plate shape. A connecting portion **120** extends upwards from the base **121**. The connecting portion **120** is located at a middle position above the base **121**, and the width of the connecting portion **120** is smaller than the width of the base **121**. Two sides of the connecting portion **120** respectively extend and are respectively bent upwards to form an elastic arm **122**. Each elastic arm **122** has two opposite arm portions **221** and a contact portion **222**. The two arm portions **221** are disposed in parallel and the contact portion **222** connects the two arm portions **221**. An insertion space **223** is formed between the contact portions **222** located on the two elastic arms **122** to allow insertion of the electronic component **2** to conduct the conductive terminal **12**.

Referring to FIG. **2** and FIG. **3**, a protruding block **123** projects downwards from a bottom surface of the base **121** for stopping the upward displacement of the solder ball **10**. When the solder ball **10** is in a molten state, the protruding block **123** penetrates into the solder ball **10**, and is in close interference with the solder ball **10**. Two sides of the protruding block **123** are respectively recessed with a recessed portion **124** for distributing the stress borne by the protruding block **123**.

Referring to FIGS. **2-4**, two fixing portions **125** extend downwards from the base **121**. The two fixing portions **125** are disposed at an interval. The fixing portion **125** is provided with a protruding barb **126** corresponding to the receiving slot **111**, which is in interference with the receiving slot **111** to fix the conductive terminal **12** into the receiving slot **111**.

Referring to FIG. **2** and FIG. **3**, the two fixing portions **125** are bent and extend towards each other to form two soldering portions **127**. The retaining space **113** is formed between the base **121** and the two soldering portions **127**. When the solder ball **10** is inserted, the solder ball **10** partially enters the retaining space **113**.

Referring to FIG. **2**, FIG. **4** and FIG. **8**, an opening **100** is formed between each soldering portion **127** and the adjacent fixing portion **125**. Each soldering portion **127** includes a soldering arm **271** and a hook portion **272** extending from a lower end of the soldering arm **271** towards the stop wall **112**. The width of the hook portion **272** is smaller than the width of the soldering arm **271**, so as to enhance the elasticity of the hook portion **272**. An upper surface of the hook portion **272** is a camber having a radian substantially conforming to a spherical surface of the solder ball **10**, and an angle formed between the hook portion **272** and the soldering arm **271** is substantially equal to the radian of the surface of the solder ball **10**, so as to increase the contact area with the solder ball **10**. A clearance **200** is formed between the two hook portions **272**. The clearance **200** separates the two hook portions **272** so that the two hook portions **272** elastically move and enter the reserved space **115** when being pressed. The opening **100** is formed between the hook portion **272** and the adjacent fixing portion **125**. When viewed laterally, each hook portion **272** has a retaining point **273** urging against a lower hemispherical surface of the solder ball **10** to hold the solder ball **10**, so as to prevent the solder ball **10** from moving downwards relative to the receiving slot **111**.

In other embodiments (not shown), the number of the fixing portion **125** may also be one. That is, a fixing portion **125** extends downwards from the base **121**. A soldering portion **127** is bent laterally and extends from the fixing portion **125**. The soldering portion **127** includes a soldering arm **271** and a hook portion **272** bent and extending from a lower end of the soldering arm **271** towards the stop wall **112**. The solder ball **10** is clamped between the soldering portion **127** and the stop wall **112**, and the hook portion **272** has a retaining point **273** urging against a lower hemispherical surface of the solder ball **10**.

In operation, referring to FIG. **2**, FIG. **5** and FIG. **6**, first, the conductive terminal **12** is inserted into the receiving slot **111** so that the base **121** is fixed in the receiving slot **111**, the protruding barb **126** located on the fixing portion **125** is buckled in the receiving slot **111** to fix the conductive terminal **12**, and the electronic component **2** is inserted into the insertion space **223**. At this time, the soldering portion **127** and the hook portion **272** are in a pre-bent state and the hook portion **272** is bent relative to the soldering arm **271**, and the soldering portion **127** is located in the retaining space **113**.

Referring to FIG. **2**, FIG. **6** and FIG. **7**, one of the solder balls **10** is correspondingly placed in the retaining space **113**. The solder ball **10** is in interference with the soldering portion **127** and the solder ball **10** presses the soldering portion **127** to elastically move towards the reserved space **115** so that the solder ball **10** is securely retained between the soldering portion **127** and the stop wall **112**. At this time, the soldering portion **127** partially enters the reserved space **115**, and the solder ball **10** partially enters the retaining space **113**.

Referring to FIG. **2**, FIG. **7** and FIG. **8**, the solder ball **10** is further inserted. The solder ball **10** presses the soldering portion **127** to elastically move towards the reserved space **115**, the retaining point **273** located on the hook portion **272** tightly urges against the lower hemispherical surface of the solder ball **10**, and the spherical surface of the solder ball **10** conforms to and contacts the upper surface of the hook portion **272**, and finally the solder ball **10** is substantially retained between the soldering portion **127** and the stop wall **112**. At this time, the elastic pressing force received by the hook portion **272** is the strongest. Since the clearance **200** exists between the two hook portions **272**, and the opening **100** exists between the hook portion **272** and the adjacent fixing portion **125**, the hook portion **272** exerts a large elastic restoring force on the solder ball **10**, so that the solder ball **10** is displaced towards the stop wall **112** to achieve further close interference of the solder ball **10** with the hook portion **272** and the stop wall **112**, so as to further tightly clamp the solder ball **10**. At this time, the elastic restoring force exerted on the solder ball **10** by the hook portion **272** is the strongest.

Referring to FIG. **2**, FIG. **7**, FIG. **8** and FIG. **9**, during high-temperature soldering, in a soldering environment without inert gases, the conductive terminal **12** is easily oxidized, and a solder paste (not shown) is provided to solder the conductive terminal **12** onto the circuit board **3** through the solder ball **10**. Since the retaining point **273** located on the hook portion **272** tightly urges against the lower hemispherical surface of the solder ball **10**, that is, the height difference between the solder paste (not shown) and the hook portion **272** is small, the solder paste (not shown) contacts the hook portion **272** over a large area, and the solder flux in the solder paste (not shown) is sufficient to remove the oxide layer on the surface of the hook portion **272**. As such, the hook portion **272** fully electrically contacts the solder ball **10**, thereby ensuring good soldering. When the solder ball **10** is in a molten state, the two hook portions **272** and the protruding block **123** penetrate into the solder ball **10**, which enhances the interference with the solder ball **10**, thereby improving the soldering effect.

Based on the above, the electrical connector of the present invention, among other things, has the following beneficial effects.

1. The hook portion **272** extends from the lower end of the soldering arm **271** towards the stop wall **112**, the solder ball **10** is clamped between the two soldering portions **127** and the stop wall **112**, and the hook portion **272** has a retaining point **273** urging against the lower hemispherical surface of the solder ball **10**, so that during transportation or other unexpected operations, the retaining point **273** can prevent the solder ball **10** from moving upwards and downwards relative to the receiving slot **111**, thereby ensuring good soldering.

2. In a soldering environment without inert gas, when the solder paste (not shown) is provided to solder the conductive terminal **12** onto the circuit board **3** located below the insulating body **11** through the solder ball **10**, since the hook portion **272** has a retaining point **273** urging against the lower hemispherical surface of the solder ball **10**, that is, the height difference between the solder paste (not shown) and the hook portion **272** is small, the solder paste (not shown) contacts the hook portion **272** over a large area, and the solder flux in the solder paste (not shown) is sufficient to remove the oxide layer on the surface of the hook portion **272**. As such, the hook portion **272** fully electrically contacts the solder ball **10**, thereby ensuring good soldering.

3. When the solder ball **10** is inserted and pressed between the soldering portion **127** and the stop wall **112**, the hook portion **272** elastically moves away from the stop wall **112**. Since the clearance **200** is formed between the two hook portions **272**, the elasticity of the hook portion **272** can be enhanced. When the solder ball **10** reaches the prearranged position, the elastic restoring force exerted on the solder ball **10** by the hook portion **272** is large, and the elastic restoration is fast, so that close interference of the hook portion **272** with the solder ball **10** can be ensured.

4. Since the opening **100** is formed between the soldering portion **127** and the adjacent fixing portion **125**, the elasticity of the soldering portion **127** can be enhanced.

5. Since the width of the connecting portion **120** is smaller than the width of the base **121**, the elasticity of the soldering portion **127** located below the base **121** can be enhanced.

6. Since the protruding block **123** projects from the bottom surface of the base **121**, when the solder ball **10** is molten, the protruding block **123** penetrates into the solder ball **10**, which enhances the interference with the solder ball **10**, thereby improving the soldering effect.

7. Since the upper surface of the hook portion **272** is a camber, the contact area between the hook portion **272** and the solder ball **10** can be increased.

8. Since the two sides of the protruding block **123** is respectively recessed with a recessed portion **124**, the recessed portions **124** can distribute the stress borne by the protruding block **123**.

The foregoing description of the exemplary embodiments of the invention has been presented only for the purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in light of the above teaching.

The embodiments are chosen and described in order to explain the principles of the invention and their practical application so as to activate others skilled in the art to utilize the invention and various embodiments and with various modifications as are suited to the particular use contemplated.

Alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims rather than the foregoing description and the exemplary embodiments described therein.

What is claimed is:

1. An electrical connector, with a plurality of solder balls arranged therein, comprising:

a) an insulating body, wherein a plurality of receiving slots are formed through the insulating body, and at least one side surface of each receiving slot forms a stop wall; and

b) a plurality of conductive terminals, received in the receiving slots, wherein each conductive terminal has a base, at least one fixing portion extends downwards from the base, a soldering portion is bent laterally and extends from the fixing portion, the soldering portion comprises a soldering arm and a hook portion bent and extending from a lower end of the soldering arm towards the stop wall, the solder ball is clamped between the soldering portion and the stop wall, and the hook portion has at least one retaining point urging against a lower hemispherical surface of the solder ball.

2. The electrical connector according to claim **1**, wherein a connecting portion extends upwards from the base, and the width of the connecting portion is smaller than the width of the base.

3. The electrical connector according to claim **1**, wherein an upper surface of the hook portion is a camber, and when the solder ball substantially enters the receiving slot, a spherical surface of the solder ball conforms to and contacts the upper surface of the hook portion.

4. The electrical connector according to claim **1**, wherein the width of the hook portion is smaller than the width of the soldering arm.

5. The electrical connector according to claim **1**, wherein an opening is formed between the hook portion and the adjacent fixing portion.

6. The electrical connector according to claim **1**, wherein a retaining space is formed between the base and the soldering portion, and the solder ball partially enters the retaining space.

7. The electrical connector according to claim **6**, wherein the retaining space extends away from the stop wall to form a reserved space allowing the hook portion to elastically move towards a side surface opposite to the stop wall when the solder ball is forced to press the soldering arm, and the reserved space is connected with the retaining space.

8. The electrical connector according to claim **1**, wherein the stop wall is recessed with a limiting groove, and the limiting groove has at least one stop surface for stopping an upward displacement of the solder ball.

9. The electrical connector according to claim **1**, wherein a protruding block for stopping the solder ball projects downwards from a bottom surface of the base, and when the solder ball is in a molten state, the protruding block penetrates into the solder ball; and two sides of the protruding block are respectively recessed with a recessed portion.

10. The electrical connector according to claim **1**, wherein the fixing portion is provided with a protruding barb corresponding to the receiving slot, which is in interference with the receiving slot to fix the conductive terminal into the receiving slot.

11. The electrical connector according to claim **1**, wherein two fixing portions extend downwards from the base, the two fixing portions are bent and extend towards each other to form two soldering portions, the two soldering portions comprise two soldering arms and two hook portions bent and extending from the lower ends of the two soldering arms towards the stop wall, the solder ball is clamped between the two soldering portions and the stop wall, a clearance is formed between the two hook portions, and the two hook portions respectively have at least one retaining point urging against the lower hemispherical surface of the solder ball.

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